CLAIMS

What is claimed is:

1. A collimating lens to transform a ray of light from a light source into approximate parallel rays, comprising:

the collimating lens made of a single lens of plastic, the single lens having a refraction surface provided on one side and a diffraction surface provided on the other side; and

the refraction surface and the diffraction surface having predetermined powers to prevent a power of the collimating lens from changing as a result of a change in temperature.

2. The collimating lens as claimed in claim 1, wherein the collimating lens and the diffraction surface of the collimating lens have a positive power.

3. The collimating lens as claimed in claim 1, wherein the refraction surface and the diffraction surface have a power to satisfy a condition of:

$$-3 \leq \frac{K_d}{K_r} \leq -2$$

where, K_d is a power of the diffraction surface, and K_r is a power of the refraction surface.

4. The collimating lens as claimed in claim 3, wherein the refraction surface and the diffraction surface have the powers to satisfy a condition of:

$$\frac{K_d}{K_r} \approx -\frac{(2n + (n+1)(n^2 + 2))}{4n}$$

where, K_d is the power of the diffraction surface, K_r is the power of the refraction surface, and n is an index of refraction of the plastic that constitutes the collimating lens.

5. The collimating lens as claimed in claim 1, wherein at least one of the refraction surface and the diffraction surface is provided as a non-spherical surface.

6. An optical scanning apparatus to project a ray of light from a light source towards a predetermined direction and to converge the ray of light on a photosensitive medium, the optical scanning apparatus comprising:

a collimating lens to transform the ray of light from the light source into parallel rays, and provided of a single plastic lens that has a refraction surface provided on one side and a diffraction surface provided on the other side, the refraction surface and the diffraction surface having predetermined powers to prevent power of the collimating lens from changing due to a change in temperature;

a cylindrical lens to converge a light component from the collimating lens, in a sub-scanning direction into a linear ray of light in a main-scanning direction;

a light deflector to deflect the linear ray from the cylindrical lens; and

an f-θ lens to converge the reflected ray of light from the light deflector onto the photosensitive medium.

7. The optical scanning apparatus as claimed in claim 6, wherein the collimating lens and the refraction surface of the collimating lens have a positive power.

8. The optical scanning apparatus as claimed in claim 6, wherein the refraction surface and the diffraction surface have powers to satisfy the condition of:

$$-3 \leq \frac{K_d}{K_r} \leq -2$$

where, K_d is the power of the diffraction surface, and K_r is the power of the refraction surface.

9. The collimating lens as claimed in claim 1, wherein the refraction surface and the diffraction surface have powers to satisfy a condition of:

$$\frac{K_d}{K_r} = -\frac{(2n + (n+1)(n^2 + 2))}{4n}$$

where, K_d is the power of the diffraction surface, K_r is the power of the refraction surface, and n is an index of refraction of the plastic that constitutes the collimating lens.

10. The collimating lens as claimed in claim 1, wherein a ratio between the power of the diffraction surface and the power of the refraction surface is an inverse of the focal distance.

11. The collimating lens as claimed in claim 1, wherein both the refraction surface and the diffraction surface are provided as non-spherical surfaces.

12. The collimating lens as claimed in claim 6, wherein at least one of the refraction surface and the diffraction surface is provided as a non-spherical surface.

13. The collimating lens as claimed in claim 6, wherein the refraction surface and the diffraction surface have powers to satisfy a condition of:

$$\frac{K_d}{K_r} = -\frac{(2n + (n+1)(n^2 + 2))}{4n}$$

where, K_d is the power of the diffraction surface, K_r is the power of the refraction surface, and n is an index of refraction of a material that constitutes the collimating lens.

14. An optical scanning apparatus capable to maintain a constant focal distance during a change in temperatures, comprising:

a light source from which a ray of light is projected via the optical scanning apparatus;

a collimating lens to modify a ray of light from a light source to cause the ray of light to become parallel, the collimating lens being provided with a lens having a refraction surface provided on one side and a diffraction surface provided on the other side, the refraction surface and the diffraction surface having predetermined powers to prevent a power of the collimating lens from changing due to change in temperature;

a diaphragm to limit a luminosity of the lights converged on the collimating lens;

a cylindrical lens to converge the linear ray components from the collimating lens, thereby creating a linear light in a main-scanning direction;

a light deflector to deflect light from the cylindrical lens towards a photosensitive medium at a constant speed; and

an f-θ lens to converge reflected ray of light from the light deflector onto the photosensitive medium.

15. A collimating lens to prevent variation of focal distance, comprising:

a refraction surface provided on one side; and

a diffraction surface provided on an opposite side, wherein the refraction and diffraction surfaces prevent a power of the collimating lens from changes due to a change in temperature.

16. The collimating lens as claimed in claim 15, wherein at least one of the refraction surface and the diffraction surface is provided as a spherical surface.

17. The collimating lens as claimed in claim 1, wherein at least one of the refraction surface and the diffraction surface is provided as a spherical surface.

18. The collimating lens as claimed in claim 3, wherein the diffraction surface has positive power and the power of the diffraction surface is larger than the power of the refraction surface by the difference which satisfies the condition of:

$$-3 \leq \frac{K_d}{K_r} \leq -2$$

where, K_d is the power of the diffraction surface, and K_r is the power of the refraction surface.

19. The collimating lens as claimed in claim 15, the collimating lens is made of a single lens.

20. The collimating lens as claimed in claim 15, the collimating lens is made of at least one plastic lens.